Climate Change and Human Health Literature Portal

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Impacts of global climate change and emissions on regional ozone and fine particulate matter concentrations over the United States

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Abstract:

[1] Simulated future summers (i.e., 2049-2051) and annual (i.e., 2050) average regional O-3 and PM2.5 concentrations over the United States are compared with historic (i.e., 2000-2002 summers and all of 2001) levels to investigate the potential impacts of global climate change and emissions on regional air quality. Meteorological inputs to the CMAQ chemical transport model are developed by downscaling the GISS Global Climate Model simulations using an MM5-based regional climate model. Future-year emissions for North America are developed by growing the U. S. EPA CAIR inventory, Mexican and Canadian emissions and by using the IMAGE model with the IPCC A1B emissions scenario that is also used in projecting future climate. Reductions of more than 50% in NOX and SO2 emissions are forecast. Impacts of global climate change alone on regional air quality are small compared to impacts from emission control-related reductions, although increases in pollutant concentrations due to stagnation and other factors are found. The combined effect of climate change and emission reductions lead to a 20% decrease (regionally varying from -11% to -28%) in the mean summer maximum daily 8-hour ozone levels (M8hO(3)) over the United States. Mean annual PM2.5 concentrations are estimated to be 23% lower (varies from -9% to -32%). Major reductions in sulfate, nitrate and ammonium PM2.5 components combined with the limited reduction in organic carbon suggests that organic carbon will be the dominant component of PM2.5 mass in the future. Regionally, the eastern United States benefits more than the rest of the regions from reductions in both M8hO(3) and PM2.5, because of both spatial variations in the meteorological and emissions changes. Reduction in the higher M8hO(3) concentrations is also estimated for all subregions and fewer days with M8hO(3) above the air quality standards in urban sites with Atlanta in the southeast benefiting most.

Source: http://dx.doi.org/10.1029/2006jd008262

Resource Description

Climate Scenario : ⊠

specification of climate scenario (set of assumptions about future states related to climate)

 Other Climate Scenario

   Other Climate Scenario: SRES A1B

Exposure : ⊠

weather or climate related pathway by which climate change affects health

Air Pollution, Temperature

Air Pollution: Ozone, Particulate Matter

Temperature: Fluctuations

Geographic Feature: ☒

resource focuses on specific type of geography

None or Unspecified

Geographic Location: ☒

resource focuses on specific location

United States

Health Impact: ☒

specification of health effect or disease related to climate change exposure

Health Outcome Unspecified

Mitigation/Adaptation: ☒

mitigation or adaptation strategy is a focus of resource

Mitigation

Model/Methodology: ☒

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type: ☒

format or standard characteristic of resource

Research Article

Timescale: ☒

time period studied

Medium-Term (10-50 years)